Appendix A

Harmonia^{+PL} – procedure for negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland

QUESTIONNAIRE

A0 | Context

Questions from this module identify the assessor and the biological, geographical & social context of the assessment.

a01. Name(s) of the assessor(s):

first name and family name

1. Monika Normant-Saremba – external expert
2. Joanna Hegele-Drywa
3. Wojciech Solarz

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr hab.	Department of Experimental Ecology of Marine Organisms, Institute of Oceanography, University of Gdansk	20-01-2018
(2)	dr	Department of Experimental Ecology of Marine Organisms, Institute of Oceanography, University of Gdansk	18-01-2018
(3)	dr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	31-01-2018

a02. Name(s) of ***the species*** under assessment:

nazwa polska: Krab wełnistoręki

nazwa łacińska: ***Eriocheir sinensis*** Milne-Edwards, 1853

English name: Chinese mitten crab

Współfinansowano w ramach projektu nr POIS.02.04.00-00-0100/16 pn. *Opracowanie zasad kontroli i zwalczania inwazyjnych gatunków obcych wraz z przeprowadzeniem pilotażowych działań i edukacją społeczną* ze środków Unii Europejskiej w ramach Programu Infrastruktura i Środowisko 2014-2020

acomm02. Comments:

Although in the first reports on this species the name "krab wełnistoręki" was used, as a literal translation from German (Wollhandkrabbe), the name "krab wełnistoszczypcy" seems more justified, as crabs do not have hands, but chelae.

Polish name (synonym I)	Polish name (synonym II)
Krab wełnistoszczypcy	–
Latin name (synonym I)	**Latin name (synonym II)**
–	–
English name (synonym I)	**English name (synonym II)**
Chinese crab	Chinese river crab

a03. **Area** under assessment:

Poland

acomm03. Comments:

–

a04. **Status** of *the species* in Poland. *The species* is:

	native to Poland
	alien, absent from Poland
	alien, present in Poland only in cultivation or captivity
X	alien, present in Poland in the environment, not established
	alien, present in Poland in the environment, established

aconf01. Answer provided with a

low	medium	high
		X

level of confidence

acomm04. Comments:

Although the Chinese mitten crab was first recorded in Poland almost one hundred years ago, it has not created a free-living population yet (Kulmatycki 1933 – P; Normant et al. 2000 – P; Wójcik-Fudalewska and Normant-Saremba 2016 – P). This is indicated by both the lack of larval and juvenile forms, as well as the presence of only large individuals with armour width of above 40 mm (Czerniejewski and Wawrzyniak 2006 – P; Wójcik-Fudalewska and Normant-Saremba 2016 – P). Individuals occurring in the area of Poland probably migrate from Germany, where a self-reproducing (naturalized) population of this species is present (Fladung 2000 – P; Czerniejewski et al. 2012 – P; Gatunki Obce w Polsce 2018 – B).

a05. The impact of the *Species* on major domains. The *Species* may have an impact on:

X	the environmental domain
	the cultivated plants domain
X	the domesticated animals domain
X	the human domain
X	the other domains

acomm05. Comments:

Chinese mitten crab, if occurs in large numbers, has a negative impact on the natural environment by feeding on native species of benthic flora and fauna, competing for food and shelter with native crustaceans, devouring roe of benthic fish or destroying aquatic vegetation (Panning 1938 – I; Hoestlandt 1945 – P; Rudnick et al. 2000 – I; Gollasch 1999 – I; Rainbow et al. 2003 – P; Gibley et al. 2008 – P; Veilleux and de Lafontaine, 2007 – I; Bouma i Soes 2010 – I; Rosewarne et al. 2016 –P; Gatunki Obce w Polsce 2018 – B; Global Invasive Species Database, 2018 – B). This species is also a place of life for many organisms, which inhabit its armour, characteristic, cuticular bristles covering chelae, as well as gills (Normant et al. 2007 – P; Sobecka et al. 2011 – P; Normant et al. 2013 – P). Taking long migrations,

crabs can participate in the spread of these organisms, as well as their introduction to new environments. Chinese mitten crab is a carrier of crayfish plague *Aphanomyces astaci*, which originates from North America and is a deadly disease of native crayfish (Schrimpf et al. 2014 – P). In this species also parasitic microsporidia *Endoreticulatus eriocheir*, which can be hazardous to other decapods and a protozoan *Epistylis* sp., which can be hazardous to fish, have been found (Steinford et al. 2011 – P; Sobecka et al. 2013 – P). Chinese mitten crab is a nutrition for numerous organisms (Panning 1938 – I; Weber 2008 – P), also for a human. As an intermediate host of Japanese lung fluke (*Paragonimus westermani*), this species can affect the health of a human, who is a definitive parasite host of this parasite (Cohen 2003 – P). Chinese mitten crab can also transform abiotic environment by burying themselves in the sludge and releasing chemical compounds contained in it, which change water quality (Bouma and Soes 2010 – I). This species can generate economic losses in the fishing industry by destroying fishing nets or damaging caught fish (Panning 1938 – I; Bouma i Soes 2010 – P). It also competes for the food base with commercially fished organisms (Rudnick and Resh 2005 – P; Gollasch 2006 – B). By digging its hiding places, Chinese mitten crab may contribute to the erosion of reservoir banks, thus also destroying embankments and other infrastructure (Panning 1938 – I; Rudnick et al. 2005a – P). In the case of mass occurrence, this species may also clog filters of devices used to collect water for cooling systems in industry (Rudnick and Resh 2005 – P; Rudnick et al. 2000 – I; Gollasch 2006 – B, Gatunki Obce w Polsce 2018 – B; Global Invasive Species Database 2018 – P).

A1 | Introduction

Questions from this module assess the risk for *the species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation. This leads to introduction, defined as the entry of *the organism* to within the limits of *the area* and subsequently into the wild.

a06. The probability for *the species* to expand into Poland's natural environments, **as a result of self-propelled expansion** after its earlier introduction outside Polish territory is:

	low
	medium
X	high

aconf02.	Answer provided with a	low	medium	high **X**	level of confidence

acomm06. Comments:

Being a catadromous species, Chinese mitten crab is adapted for long migrations, during which it can travel even up to 20 km per day (Panning 1938 – I). As a walking organism, it is perfectly adapted, both morphologically (long walking limbs) and physiologically (effective metabolism outside the aquatic environment) for long migrations, also by land (Olthof 1936 – P; De Giosa and Czerniejewski 2011 – P). This species is also very resistant to drying (Fialho et al. 2016 – P). Chinese mitten crab, thanks to strong, muscular walking limbs ending with a sharp dactylus (claw), can also climb vertical surfaces, effectively overcoming physical barriers present in the path of its migration (Peters and Hoppe 1938 – P). After the introduction to German waters in 1912, this species expanded spontaneously to the neighbouring countries (including Poland) at a rate estimated at several hundred kilometres a year (Herborg et al. 2003 – P; Herborg et al. 2005 – P; Ojaveer et al. 2007 – P).

a07. The probability for *the species* to be introduced into Poland's natural environments by **unintentional human actions** is:

	low
X	medium
	high

aconf03.	Answer provided with a	low	medium	high **X**	level of confidence

acomm07. Comments:

Larvae and juvenile individuals of Chinese mitten crab can be transported over long distances in ballast water of ships (Cohen and Carlton 1997 – P) arriving to Polish ports from regions, where this species reproduces, e.g. from the North Sea or the western Baltic Sea. However, due to the entry into force on 8 September 2017 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, ship-owners will be required to purify water from living organisms before being released from ballast tanks to the environment in the port of destination. In practice, this will significantly limit a potential release of Chinese mitten crab to the natural environment of Poland. Moreover, the occurrence of larvae of this species in the coastal zone is limited only to a certain period of the year (Anger 1991 – P). Based on the above information, the number of larval release to the natural environment is estimated at above 1, but no more than 10 cases per decade. It should also be considered that larvae of this species, transported in ballast waters, are not able to develop in the natural environment of Poland because of too low salinity – in the temperate zone, a complete larval development occurs at approximately 20 PSU (Carlton 1985 – P; Anger 1991 – P; Rudnick et al. 2005b – P). Moreover, after releasing from ballast tanks, larvae can die as a result of osmotic shock, as they are weak osmoregulators. Also, habitat conditions in Poland seem unfavourable to the development of juvenile crabs. For nearly 100 years, since this species appeared in Poland, no larvae or juvenile individuals, but only large adult crabs have been found (Czerniejewski and Wawrzyniak 2006 – P; Wójcik-Fudalewska and Normant-Saremba 2016 – P).

a08. The probability for *the species* to be introduced into Poland's natural environments by **intentional human actions** is:

X	low
	medium
	high

aconf04.	Answer provided with a	low	medium **X**	high	level of confidence

acomm08. Comments:

It is unlikely that Chinese mitten crab would be imported to Poland intentionally, e.g. by restaurateurs or aquarists. Based on the information obtained from fishermen fishing this species in Poland, it can be concluded that it does not arouse interest among potential consumers (M. Normant-Saremba, own information). Aquarium companies are neither interested in this species (M. Normant-Saremba, own information). For this reason, there is also a low probability, that individuals of this species could be intentionally released to the natural environment of Poland.

A2 | Establishment

Questions from this module assess the likelihood for *the species* to overcome survival and reproduction barriers. This leads to *establishment*, defined as the growth of a population to sufficient levels such that natural extinction within *the area* becomes highly unlikely.

a09. Poland provides a **climate** that is:

	non-optimal
X	sub-optimal
	optimal for establishment of *the species*

aconf05.	Answer provided with a	low	medium	high **X**	level of confidence

acomm09. Comments:

The native regions of the occurrence of Chinese mitten crab are eastern coasts of Asia, from Vladivostok to Taiwan (Panning 1938 – I). Therefore, this species inhabits both the temperate and subtropical zone (CABI 2018 – B). The climatic similarity, as well as the wide range of tolerance of this species to temperature, indicate the possibility of its establishment in Poland (Panning 1938 – I; Jakubowska and Normant 2011 – P).

a10. Poland provides **habitat** that is

X	non-optimal
	sub-optimal
	optimal for establishment of *the species*

aconf06.	Answer provided with a	low	medium	high **X**	level of confidence

acomm10. Comments:

In Poland, Chinese mitten crab most often inhabits shallow reservoirs in the coastal zones of the Baltic Sea, characterized by salinity in the range of 0,5-7 psu (the Oder estuary, the Vistula Lagoon or Gdańsk Bay). Habitat conditions (abiotic and biotic) in reservoirs, in which this species occurs are very diversified, which only confirms the fact that it is very flexible. It is the largest species of crustaceans in Poland, which has practically no natural enemies. Additionally, thanks to the ability for self-propelled expansion, it can easily change the habitat if the conditions are unfavourable. This species does not reproduce in Poland, despite the fact that in Gdańsk Bay reproducing females have been recorded (Wójcik i Normant 2014 – P). However, during the twenty years of the study of this species, only four such individuals were caught. This indicates the fact that salinity in Poland is even too low for the female to lay eggs. Eggs are glued to the abdomen with a substance that requires a salinity higher than 7 PSU to harden, otherwise the eggs will fall out (Panning 1938 – P Peters and Hoppe 1938 – P). Moreover, for nearly 90 years, since this species appeared in Poland, no larvae or juvenile individuals, but only large adult crabs have been found (Czerniejewski and Wawrzyniak 2006 – P; Wójcik-Fudalewska and Normant-Saremba 2016 – P). Larvae of Chinese mitten crab (especially intermediate stages, i.e. zoea 2-5) have a very low tolerance to low salinity, and therefore require seawater for development (Anger 1991 – P, Montú et al. 1996 – P).

A3 | Spread

Questions from this module assess the risk of *the species* to overcoming dispersal barriers and (new) environmental barriers within Poland. This would lead to spread, in which vacant patches of suitable habitat become increasingly occupied from (an) already-established population(s) within Poland.

Note that spread is considered to be different from range expansions that stem from new introductions (covered by the Introduction module).

a11. The capacity of *the species* to disperse within Poland by natural means, **with no human assistance**, is:

	very low
	low
	medium
	high
X	very high

aconf07.	Answer provided with a	low	medium	high **X**	level of confidence

acomm11.	Comments: Dispersion from a single source (data type: A) Since the end of the 1990s, a constant occurrence of large crabs, mainly in oligo- and mesohaline reservoirs situated in both north-western, e.g. the Oder estuary and Szczecin Lagoon and north-eastern, e.g. the Vistula Lagoon, Poland, have been observed (Normant et al. 2002 – P; Czerniejewski and Wawrzyniak 2006 – P; Wójcik-Fudalewska and Normant-Saremba 2016 – P). It is assumed that these individuals originate from a population living in the area of Germany (Czerniejewski et al. 2012 – P). The lack of larvae and juvenile individuals (which could have been for example introduced in the ballast tanks of ships) in the environment, additionally confirms these assumptions. Therefore, it can be concluded that the capacity to disperse of the species in Poland is very high, of the order of several hundred kilometres per year. Chinese mitten crab is an aquatic and terrestrial walking organism, and its high mobility is related to its life cycle proceeding in two different environments – fresh and seawater (Panning 1938 – I; Herborg et al. 2003 – P). Chinese mitten crab is physiologically and morphologically very well adapted to long migrations – the individuals of this species can remain outside the water in wetlands even up to 35 days, hide in their burrows for up to 10 days during drought, as well as climb vertical surfaces thanks to specially structured strong limbs (Olthof 1936 – P; Panning 1938 – I; Nepszy and Leach 1973 – P; Peters and Hoppe 1938 – P; Veldhuizen and Stanish 1999 – I; De Giosa and Czerniejewski 2011 – P).

a12. The frequency of the dispersal of *the species* within Poland by **human actions** is:

X	low
	medium
	high

aconf08.	Answer provided with a	low	medium	high **X**	level of confidence

acomm12.	Comments: It is unlikely that humans would directly participate in the dispersal of Chinese mitten crab in the area of Poland, as this species is in no way used by them. This species is not of interest of aquarists or restaurateurs, as indicated by information obtained from fishermen finishing this species or aquarium companies (M. Normant-Saremba, own information). There are also no aquacultures of bivalves, during the transport of which *E. sinensis* could be incidentally dispersed in the area of Poland.

A4a | Impact on the environmental domain

Questions from this module qualify the consequences of *the species* on wild animals and plants, habitats and ecosystems.

Impacts are linked to the conservation concern of targets. Native species that are of conservation concern refer to keystone species, protected and/or threatened species. See, for example, Red Lists, protected species lists, or Annex II of the 92/43/EWG Directive. Ecosystems that are of conservation concern refer to natural systems that are the habitat of many threatened species. These include natural forests, dry grasslands, natural rock outcrops, sand dunes, heathlands, peat bogs, marshes, rivers & ponds that have natural banks, and estuaries (Annex I of the 92/43/EWG Directive).

Native species population declines are considered at a local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as (near) extinction. Similarly, limited ecosystem change is considered as transient and easily reversible; severe change is considered as persistent and hardly reversible.

a13. The effect of *the species* on native species, through **predation, parasitism or herbivory is**:

	inapplicable
	low

X	medium
	high

aconf09.	Answer provided with a	low	medium	high **X**	level of confidence

acomm13. Comments:

Chinese mitten crab is an omnivorous species, and its diet may vary both depending on sex and size of individuals, and on the habitat and season (Zhu et al. 1997 – P; Fladung 2000 – P; Jin et al. 2001 – P; Veldhuizen 2001 – P; Jin 2003 – P). This species, as a walking organism, cannot effectively hunt for quick victims. Instead, it is equipped with massive chelae, which enable him to cut aquatic plants and crush shells of molluscs (Wójcik et al. 2015 – P). Chinese mitten crab can also feed on roe, which, however, constitute a small percentage of its diet (Veilleux and de Lafontaine 2007 – P; Webster i in. 2015 – P). The results of previous studies indicate that the share of animal and plant organisms in the diet of adult Chinese mitten crabs from the Oder estuary is small and does not exceed 11% (Czerniejewski et al. 2010 – P). In many regions, the dead organic matter constitutes a big share in the diet of this species (Rogers 2000 – P; Czerniejewski et al. 2010 – P). However, in the literature there no information on the effect of Chinese mitten crab on changes in the abundance of species it feeds on. However, based on the previous information on the diet of this species, and assuming that it will be dispersed throughout Poland, it can be supposed that this impact will be medium. However, it is unlikely that species of special concern, which usually do not occur in large numbers in the environment, constitute a part of its diet.

a14. The effect of *the species* on native species, through **competition** is:

X	low
	medium
	high

aconf10.	Answer provided with a	low	medium	high **X**	level of confidence

acomm14. Comments:

Chinese mitten crab can compete for food with other large crustaceans, e.g. crabs in seawater or crayfish in fresh water (Veldhuizen and Stanish 1999 – I ; Rudnick et al. 2000 – P; Gollasch 2006 – B; Veilleux i de Lafontaine 2007 – I; Global Invasive Species Database 2018 – B). However, such a situation occurs when the abundance of both species is high and food resources are insufficient. In Poland, there is no population of Chinese mitten crab, and only adult crabs, whose abundance is relatively low, are recorded (Czerniejewski et al. 2010 – P; Normant et al. 2002 – P; Wójcik-Fudlewska and Normant-Saremba 2016 – P). Additionally, in reservoirs, where the crab is the most numerous, i.e. the Oder estuary and the Vistula Lagoon, there are no native crabs and crayfish.

a15. The effect of *the species* on native species, through **interbreeding** is:

X	no / very low
	low
	medium
	high
	very high

aconf11.	Answer provided with a	low	medium	high **X**	level of confidence

acomm15. Comments:

There are no native crab species in Poland.

a16. The effect of *the species* on native species by **hosting pathogens or parasites** that are harmful to them is:

	very low
	low
	medium
	high
X	very high

aconf12.	Answer provided with a	low	medium	high **X**	level of confidence

acomm16. Comments:

Chinese mitten crab is a carrier of crayfish plague *Aphanomyces astaci*, which originates from North America and is a deadly disease of native crayfish (Schrimpf et al. 2014 – P). This pathogen is on the list of the World Organisation for Animal Health (OIE). It settles on the armour of crayfish, which it subsequently pierces, growing into the interior of the body. It can cause a progressive paralysis, autotomy (discard) of the limbs and moving ashore. In this species also parasitic microsporidia *Endoreticulatus eriocheir*, which can be hazardous to other decapods and a protozoan *Epistylis* sp., which can be hazardous to fish, have been found (Steinford et al. 2011 – P; Sobecka et al. 2011 – P). Although there are no studies which would unambiguously confirm the participation of Chinese mitten crab in infecting other crustaceans with these pathogens, it is potentially possible. It also seems that due to the fact that there is no Chinese mitten crab population in Poland, and the abundance of large individuals is relatively low, the effect of this species on pathogen transmission is also small. However, the capacity to disperse of this species over long distances in a relatively short period, which may be important in the dispersion of pathogens, should also be considered.

a17. The effect of *the species* on ecosystem integrity, by **affecting its abiotic properties** is:

X	low
	medium
	high

aconf13.	Answer provided with a	low	medium	high **X**	level of confidence

acomm17. Comments:

Chinese mitten crab can disturb the structure of the sludge in a reservoir by burying itself inside. In reservoirs where the water level changes, it can also dig burrows in the banks, which are its hiding places. At high densities the effect of such activity in the first case may be a release of chemical compounds deposited in the bottom, which may consequently lead to local changes in water quality, while in the second case, to the destruction of coastal vegetation, which is an important element of the ecosystem (Veilleux and de Lafontaine, 2007 – I; Bouma and Soes 2010 – I). However, considering the fact that changes of this kind in the habitat seem to be of reversible type, the effect of Chinese mitten crab was determined to be low.

a18. The effect of *the species* on ecosystem integrity, by **affecting its biotic properties** is:

X	low
	medium
	high

aconf14.	Answer provided with a	low	medium	high **X**	level of confidence

acomm18. Comments:

As an omnivorous organism, Chinese mitten crab does not have a cascade effect on the trophic network. However, as a species migrating over long distances, it can take part in

	the dispersion of organisms, which inhabit its armour and cuticular appendices growing on its chelae (Normant et al. 2007 – P; Normant et al. 2013 – P). However, there is no information on the impact it can have on the ecosystem.

A4b | Impact on the cultivated plants domain

Questions from this module qualify the consequences of *the species* for cultivated plants (e.g. crops, pastures, horticultural stock).

For the questions from this module, consequence is considered 'low' when presence of *the species* in (or on) a population of target plants is sporadic and/or causes little damage. Harm is considered 'medium' when *the organism's* development causes local yield (or plant) losses below 20%, and 'high' when losses range >20%.

a19. The effect of *the species* on cultivated plant targets through **herbivory or parasitism** is:

	inapplicable
X	very low
	low
	medium
	high
	very high

aconf15.	Answer provided with a	low	medium	high **X**	level of confidence

acomm19.	Comments: Chinese mitten crab does not feed on cultivated plants, and it is not a parasite of plants.

a20. The effect of *the species* on cultivated plant targets through **competition** is:

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf16.	Answer provided with a	low	medium	high	level of confidence

acomm20.	Comments: The species is an animal and does not compete with plants.

a21. The effect of *the species* on cultivated plant targets through **interbreeding** with related species, including the plants themselves is:

X	inapplicable
	no / very low
	low
	medium
	high
	very high

aconf17.	Answer provided with a	low	medium	high	level of confidence

acomm21.	Comments: The species is an animal.

a22. The effect of *the species* on cultivated plant targets by **affecting the cultivation system's integrity** is:

X	very low
	low
	medium
	high
	very high

aconf18.	Answer provided with a	low	medium	high **X**	level of confidence

acomm22. Comments:

It is very unlikely that Chinese mitten crab can in any way affect the condition or yield of cultivated plants.

a23. The effect of *the species* on cultivated plant targets by hosting **pathogens or parasites** that are harmful to them is:

X	very low
	low
	medium
	high
	very high

aconf19.	Answer provided with a	low	medium	high **X**	level of confidence

acomm23. Comments:

It is very unlikely that Chinese mitten crab is a host or vector of pathogens and parasites hazardous to cultivated plants.

A4c | Impact on the domesticated animals domain

Questions from this module qualify the consequences of *the organism* on domesticated animals (e.g. production animals, companion animals). It deals with both the well-being of individual animals and the productivity of animal populations.

a24. The effect of *the species* on individual animal health or animal production, through **predation or parasitism** is:

	inapplicable
	very low
X	low
	medium
	high
	very high

aconf20.	Answer provided with a	low	medium **X**	high	level of confidence

acomm24. Comments:

Chinese mitten crab is equipped with massive chelae, used for predation on bivalves, e.g. blue mussel (Wójcik et al. 2015 – P). Therefore, it may pose a potential hazard to the aquaculture of these organisms in the coastal zone. However, in Poland molluscs are not cultivated in the coastal zone. As a walking organism, Chinese mitten crab cannot effectively hunt for quick victims, but large individuals can e.g. feed on weaker (ill) fish kept in ponds. Although there is no detailed information on this subject, it seems that the probability of such behaviour is medium, i.e. it can occur in 1 to 100 cases of predation per 100,000 fish.

a25. The effect of *the species* on individual animal health or animal production, by having properties that are hazardous upon **contact**, is:

	very low
	low
X	medium
	high
	very high

aconf21.	Answer provided with a	low	medium **X**	high	level of confidence

acomm25. Comments:

There is a probability of the effect of this species on aquaculture of bivalves by damaging their shells without subsequent consumption (Wójcik et al. 2015 – P). However, in Poland molluscs are not cultivated in the coastal zone. Presumably, Chinese mitten crab can hurt weaker (ill) fish kept in ponds. In Germany, in the years 1994-2004, losses caused by such a negative effect, as well as devouring farmed fish feed by this species, were estimated at 75,000 –100 000 euro (Gollasch et al. 2006 – P). Although there is no detailed information on this subject, it seems that the probability of such behaviour is medium, i.e. it can occur in 1 to 100 cases of direct contact per 100,000 fish per year.

a26. The effect of *the species* on individual animal health or animal production, by hosting **pathogens or parasites** that are harmful to them, is:

	inapplicable
	very low
	low
	medium
	high
X	very high

aconf22.	Answer provided with a	low	medium	high **X**	level of confidence

acomm26. Comments:

Chinese mitten crab is an intermediate host of a parasitic species of fluke *Paragonimus westermani*, which causes paragonimiasis in mammals (Bouma and Soes 2010 – I). The infection takes place after the consumption of raw crabs and therefore, the risk of consumption and infection of farm and domesticated animals is low. Because of the possibility of transmitting crayfish plague *Aphanomyces astaci* (present in the OIE list) causing death of European crayfish *Astacus astacus* (Shrimpf et al. 2014 – P), Chinese mitten crab can have a very large impact on animal production in open aquacultures (pond cultures) of this species.

A4d | Impact on the human domain

Questions from this module qualify the consequences of *the organism* on humans. It deals with human health, being defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (definition adopted from the World Health Organization).

a27. The effect of *the species* on human health through **parasitism** is:

X	inapplicable
	very low
	low
	medium

	high
	vert high

aconf23.	Answer provided with a	low	medium	high	level of confidence

acomm27. Comments:

This species is not a parasite.

a28. The effect of *the species* on human health, by having properties that are hazardous upon **contact**, is:

X	very low
	low
	medium
	high
	very high

aconf24.	Answer provided with a	low	medium	high **X**	level of confidence

acomm28. Comments:

Crabs have massive chelae, which in the moment of danger clench with great force on the opponent. If a human catches a crab improperly, skin damage can occur. Even at wide dispersion of this species, the probability of a direct contact of a crab with a human is low – less than one case per 100,000 humans, and the effect on human heath is small, which does not lead to any permanent damage.

a29. The effect of *the species* on human health, by hosting **pathogens or parasites** that are harmful to humans, is:

	inapplicable
	very low
	low
X	medium
	high
	very high

aconf25.	Answer provided with a	low	medium	high **X**	level of confidence

acomm29. Comments:

Chinese mitten crab is an intermediate host of a parasitic species of fluke *Paragonimus westermani*, which causes paragonimiasis in humans, which is currently already pharmalogically curable (Gollasch 2006 – B; Bouma and Soes 2010 – I). The infection occurs after consumption of raw crabs, containing metacercariae of this parasite. The fluke parasites in the lung parenchyma of humans, causing a formation of cysts easily undergoing bacterial infections. In Europe, there have been so far no cases of both the occurrence of this parasite in Chinese mitten crab and an infection of a human (Bouma and Soes 2010 – I). In Poland, Chinese mitten crab is not consumed, which further decreases the risk of infection.

A4e | Impact on other domains

Questions from this module qualify the consequences of *the species* on targets not considered in modules A4a-d.

a30. The effect of *the species* on causing damage to **infrastructure** is:

	very low
	low

X	medium
	high
	very high

aconf26.	Answer provided with a	low	medium	high X	level of confidence

acomm30. Comments:

Individuals of this species, especially small, occurring in high density, dig hiding places on the banks of reservoirs, in which fluctuations of water level occur, may contribute to the destruction of embankments and other infrastructure (Peters and Panning 1933 – P; Adema 1991 – P; Rudnick et al. 2005a – P) and cause bank erosion. In Poland there is no population of Chinese mitten crab and there are no small individuals (Czerniejewski et al. 2010 – P; Wójcik-Fudalewska and Normant-Saremba 2016 – P). This species can also destroy personal property of fishermen, i.e. fishing nets, contributing to economic losses (Bouma and Soes 2010 – I; Wójcik-Fudalewska et al. 2016 – P), as well as block the inlets of cooling system pipes used in various branches of industry (Hieb 1998 – P; Huver and Smit 2005 – I; Soes et al. 2007 – I). The impact of Chinese mitten crab on infrastructure seems to be moderate, as the results of the activity of this species are partly reversible (e.g. damaged embankments or damaged nets can be repaired).

A5a | Impact on ecosystem services

Questions from this module qualify the consequences of *the organism* on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of *the species*.

a31. The effect of *the species* on **provisioning services** is:

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

aconf27.	Answer provided with a	low	medium	high X	level of confidence

acomm31. Comments:

On one hand this species can damage fishing equipment, as well as caught fish (Kamps 1937 – P; Huver and Smit 2005 – I; Bouma and Soes 2010 – I), however, on the other hand, thanks to its taste and nutritional values, it is a delicacy for the Asian population, which is also very numerous in Europe (Chen et al. 2007 – P). For the latter reason, in some European countries, such as the Netherlands or Germany, Chinese mitten crab is caught by fishermen, and subsequently sold to Asian restaurants, generating high economic benefits (Bouma and Soes 2010 – P). However, in Poland this species occurs in small abundance, and apart from this, there is no information about its consumption by humans so far. In countries, where Chinese mitten crab is established, small individuals are used as fishing bait for recreational eel fishing, while large individuals as an additive to feeds for cattle and poultry, as well as a fertilizer in the agriculture or a material for the production of cosmetics (Gollasch 1999 – I).

a32. The effect of *the species* on **regulation and maintenance services** is:

	significantly negative
	moderately negative

X	neutral
	moderately positive
	significantly positive

aconf28.	Answer provided with a	low	medium	high X	level of confidence

acomm32. Comments:

Chinese mitten crab, as a detritivore, feeding on dead plant and animal remains, performs the function of a cleaner in the inhabited reservoirs (Rogers 2000 – I; Czerniejewski et al. 2010 – P). On the other hand, this species, while digging hiding places may contribute to the erosion of the banks of reservoirs, thus also destroying embankments and other infrastructure (Panning 1938 – I; Rudnick et al. 2005a – P).

a33. The effect of *the species* on **cultural services** is:

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

aconf29.	Answer provided with a	low	medium	high X	level of confidence

acomm33. Comments:

Chinese mitten crab is important for the Asian community for culinary reasons. In the Jangsu province in China a museum in the shape of this crab was built. In Poland, where there are no native species of crabs, this species arouses interest of the society and scientists. This species is able to steal fishing bait from anglers during recreational angling, and its habit of digging burrows on the banks of reservoirs may disturb their aesthetics (Peters and Panning 1933 – P, Kamps 1937 – P; Hieb and Veldhuizen – P, 1998; Soes et al. 2007 – I; Bouma and Soes 2010 – I).

A5b | Effect of climate change on the risk assessment of the negative impact of the Species

Below, each of the Harmonia^{+PL} modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest taking into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes in atmospheric variables listed in its 2013 report on the physical science basis may be used for this purpose. The global temperature is expected to rise by 1 to 2°C by 2046-2065.

Note that the answers to these questions are not used in the calculation of the overall risk score, but can be but can be considered when decisions are made about management of *the species*.

a34. INTRODUCTION – Due to climate change, the probability for *the species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf30.	Answer provided with a	low	medium	high X	level of confidence

acomm34.	Comments: Chinese mitten crab has been present in Poland for several decades, although it did not create a population. It is capable of self-propelled expansion and overcoming a geographical barrier, migrating from the area of Germany, where its population is present, to Poland, where low water salinity constitutes a physiological barrier to a formation of population. Moreover, the forecasts for the Baltic Sea predict that climate change will lead to a further reduction in salinity (IMGW 2014 – I). Thus, climate change does not seem to have an impact in this area.

a35. ESTABLISHMENT – Due to climate change, the probability for *the species* to overcome barriers that have prevented its survival and reproduction in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf31.	Answer provided with a	low	medium	high **X**	level of confidence

acomm35.	Comments: The species is already present in Poland, where there are favorable climatic conditions for adult individuals (Jakubowska and Normant 2011 – P). However, it is unlikely that the temperature increase in the range of forecast changes would contribute to overcoming a barrier for the establishment of this species in Poland, which is too low salinity (Anger 1991 – P), especially because the forecasts for the Baltic Sea predict that climatic change will generate a further increase in this factor (IMGW 2014 – I). Although larval tolerance to low salinity increases with temperature (Anger 1991 – P; Montú et al. 1996 – P), however, as the studies have shown, even at the salinity of 10 PSU, which is higher than in the Polish Marine Areas, the temperature of 18°C is too low for the larvae to survive (Anger et al. 1991 – P). Moreover, in spring, when the development of crab larvae takes place, the temperature of water in the Polish Marine Areas is much lower than the minimum, at which they can properly develop. It should also be considered that crab larvae do not develop in surface water, which warms up the fastest.

a36. SPREAD – Due to climate change, the probability for *the species* to overcome barriers that have prevented its spread in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf32.	Answer provided with a	low	medium	high **X**	level of confidence

acomm36.	Comments: Chinese mitten crab has great capabilities of self-propelled expansion in Poland and climate changes do not seem to be able to contribute to any changes.

a37. IMPACT ON THE ENVIRONMENTAL DOMAIN – Due to climate change, the consequences of *the species* on wild animals and plants, habitats and ecosystems in Poland will:

	decrease significantly
	decrease moderately

X	not change
	increase moderately
	increase significantly

aconf33.	Answer provided with a	low	medium	high **X**	level of confidence

acomm37.	Comments: If, because of climate change, the status of this species in Poland will not change, i.e. there will be no self-reproducing population, the abundance and spread of this species will not change and therefore, it is unlikely that the effect on the environment would change.

a38. IMPACT ON THE CULTIVATED PLANTS DOMAIN – Due to climate change, the consequences of *the species* on cultivated plants and plant domain in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf34.	Answer provided with a	low	medium	high **X**	level of confidence

acomm38.	Comments: In Poland, Chinese mitten crab has no impact on cultivated plants domains and is unlikely that the situation will change as a result of climate change.

a39. IMPACT ON THE DOMESTICATED ANIMALS DOMAIN – Due to climate change, the consequences of *the species* on domesticated animals and animal production in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf35.	Answer provided with a	low	medium	high **X**	level of confidence

acomm39.	Comments: If, because of climate change, the status of this species in Poland will not change, i.e. there will be no self-reproducing population, the abundance and spread of this species will not change and therefore, it is unlikely that the effect on farm and domesticated animals would change.

a40. IMPACT ON THE HUMAN DOMAIN – Due to climate change, the consequences of *the species* on human in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf36.	Answer provided with a	low	medium	high **X**	level of confidence

acomm40.	Comments:

If climate change in the forecast range do not influence the status of this species in Poland, i.e. there is no self-reproducing population, and therefore the abundance and spread of Chinese mitten crab does not significantly change, it is also highly probable that the effect of this species on humans through a transfer of Japanese lung fluke *Paragonimus westermani*, for which it is an intermediate host, will not change. Moreover, the risk of infection does not only depend on the crab, which is the second intermediate host, but also on the occurrence in Europe of the first intermediate host or on a change in food preferences of humans – the infection with larvae of this parasite follows a consumption of raw crabs, and in Poland there is no tradition of consuming this species, as it is in Asia or in the countries of Western Europe.

a41. IMPACT ON OTHER DOMAINS – Due to climate change, the consequences of *the species* on other domains in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf37.	Answer provided with a	low	medium	high **X**	level of confidence

acomm41.	Comments:

If, because of climate change, the status of this species in Poland will not change, i.e. there will be no self-reproducing population, the abundance and spread of this species will not change and therefore, it is unlikely that the effect on infrastructure would change.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.50	0.83
Establishment (questions: a09-a10)	0.25	1.00
Spread (questions: a11-a12)	0.50	1.00
Environmental impact (questions: a13-a18)	0.25	1.00
Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.58	0.67
Human impact (questions: a27-a29)	0.25	1.00
Other impact (questions: a30)	0.50	1.00
Invasion (questions: a06-a12)	0.42	1.00
Impact (questions: a13-a30)	0.58	0.93
Overall risk score	0.24	
Category of invasiveness	moderately invasive alien species	

A6 | Comments

This assessment is based on information available at the time of its completion. It has to be taken into account, however, that biological invasions are, by definition, very dynamic and unpredictable. This unpredictability includes assessing the consequences of introductions of new alien species and detecting their negative impact. As a result, the assessment of the species may change in time. For this reason it is recommended that it is regularly repeated.

acomm42.	Comments: *Eriocheir sinensis* has been included in the list of 100 most invasive alien species. It should be emphasized that in the areas, where the physico-chemical conditions of the environment are within the range of its wide spectrum of tolerance, it occurs extensively, having a significantly negative impact both on ecosystems, in which it is recorded, and the human economy. However, despite widening the range of the occurrence of this species in the area of Poland, the extensive appearance of this species seems unlikely, mainly due to low salinity, which prevents this species from reproducing and establishing a population. Therefore, despite such high invasiveness of Chinese mitten crab, its occurrence in Poland probably will not be associated with exerting a negative impact both on the natural environment and the human economy.

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